Title: **Spaceflight Microbiology: Benefits for Long Duration Spaceflight and Our Understanding of Microorganisms on Earth**

Spaceflight microbiology is composed of both operational and experimental components that complement each other in our understanding of microbial interactions and their responses in the microgravity of spaceflight. Operationally, efforts to mitigate microbiological risk to the crew and the spacecraft have historically focused on minimizing the number of detectable organisms, relying heavily on preventative measures, including appropriate vehicle design, crew quarantine prior to flight, and stringent microbial monitoring. Preflight monitoring targets have included the astronauts, spaceflight foods, potable water systems, the vehicle air and surfaces, and the cargo carried aboard the spacecraft. This approach has been very successful for earlier missions; however, the construction and long-term habitation of the International Space Station (ISS) has created the need for additional inflight monitoring of the environment and potable water systems using hardware designed for both in-flight microbial enumeration and sample collection and return to Earth. In addition to operational activities, the ISS is providing a research platform to advance our understanding of microbiomes in the built environment. Adding to the research possibilities of this system are multiple reports of unique changes in microbial gene expression and phenotypic responses, including virulence and biofilm formation, in response to spaceflight culture. The tremendous potential of the ISS research platform led the National Research Council to recommend that NASA utilize the ISS as a microbial observatory. Collectively, the findings from operational and research activities on the ISS are expected to both enable future space exploration and translate to basic and applied research on Earth.